

NOTES ON THE TRANSFORMATIONS OF THE
HIGHER HYMENOPTERA.—I.

BY A. S. PACKARD.

The following descriptions of the larval and pupal stages of some of our more common Hymenoptera belonging to the fossorial families, together with the wasps and bees, were drawn up over twenty years ago and were preserved in the hope of adding others. But lack of time and material has prevented such additions and what few notes have been gathered are now offered for publication. The descriptions are, so far as possible, comparative, as this is especially needful in the case of larvæ whose mode of life is so similar, and which therefore present very slightly marked specific as well as generic characters. In no group of animals, perhaps, are there such slight larval characteristics as in those of the Hymenoptera, the phytophagous forms being excepted. This is evidently due to their living confined in closed cells, to their lack of the necessity or power of locomotion, and to the fact that immediately after birth they can feed on food, whether vegetable, such as pollen, or the bodies of other insects or spiders stored up for them by the prevision of their parents. They live in total darkness, hence are eyeless; they have no enemies to shun, hence have no defensive spines or armature of any kind. The reduction in the limbs and mouth-parts, and the lack of any differentiation in form, ornamentation, or color of the integument; even the undeveloped proctodæum, all tend to prove that the larval forms of these Hymenoptera are due to modifications from simple disuse, for their embryology shows that they have descended from insects whose larval forms were out-of-door feeders, probably like those of the saw-flies, and provided like them with abdominal as well as thoracic legs.

It is to be hoped that our entomologists will hereafter pay more attention to the habits of our wasps and bees, for the wonderful differentiation of the bodies of the adults is correlated with their varied and striking modes of life and their high degree of intelligence.

***Pompilus funereus* St. Farg.**

Larva.—This larva is with some hesitation referred to the above species, but it belongs to a common New England species. The head is round, scarcely longer than broad; the surface of the front not very convex, being much shorter and broader than in *Polistes*. Eyes on the

front edge, with a long oblique testaceous line, a little angulated opposite the base of the clypeus. Antennal tubercle situated on the outer edge of a round area opposite the base of the clypeus; supra-clypeal piece obtuse, the suture separating it from the epicranium indistinct. Clypeus transverse, half as long as broad; the sides very oblique, marked by testaceous oblique lines; front edge straight. Labrum broad, being one-third as long as broad; thin, flat, bilobate, overlapping the mandibles, but so thin and expanded that they can be seen through. Mandibles unusually short, stout, thick and broad, not much longer than broad, unidentate, the outer edge produced into a short obtuse point; within curved towards the retreating inner edge. Maxillæ smaller and slenderer than usual, ending in the maxillary palpi, which are short papillæ. Labium as usual, with two papilliform palpi, between which is the rudiment of the lingua, forming a transverse chitinous line. In my two alcoholic specimens the head is bent upon the breast, nearly reaching the middle of the body. The body is very short and broad, dilating in the middle. The end is unusually acute, the lateral region is more prominent, convex and tuberculated than any of the genera of other allied families; much more so than in *Odynerus*. The segments are unusually short, dorsally thickened posteriorly, giving a serrate appearance to the outline of the body, the tip sternally is much exerted and of the same size with the tergite; the two forming a terminal rounded knob.

In its round flattened head bent forward and under the body, the broad transverse clypeus and broad short bilobate thin transparent labrum, and especially the one-toothed, short, broad mandible which differs entirely in form from the other genera previously noticed, we probably have mostly family characters separating the Pompilidæ from the Sphegidæ and Larridæ and other families. It widely differs from the larval *Pelopæus* in its short flattened body and prominent pleurites, and thickened rings generally, but it approaches it in the head-characters, which are the most reliable, in its transverse clypeus and thin bilobate labrum, and in the short mandibles; but they are still much stouter, and the clypeus and labrum are less exerted, while the head is shorter, broader and rounder.

Chalybion cœruleum (*Linn.*).

Larva.—The specimens occurred at Kelly's Island, Ohio.

Head longer than broad; full convex, with a slight mesial impression; the anterior and inner edge of the eyes marked by a curvilinear

testaceous or chitinous line, opposite and just within the lower end of which are situated the antennal rudiments, situated in a round depression. Supraclypeal piece obscurely marked at the base. Clypeus subtrapezoidal, angular in the middle on each side; twice as broad as long; base and front edge transverse, the front edge slightly concave, exerted so as partially to envelop the base of the mandibles. Labrum very free, exerted and overlapping the mandibles; more than twice as broad as long, bilobate, the corners rounded, the front edge excavated; thin, translucent. Mandibles short, twice as long as broad at base, tridentate, the mesial tooth largest, the inner smallest. Maxillæ rather long and slender. Rudiments of the palpi acute, longer and more pointed than usual. Labium a little wider than usual, the rudiments of the labial palpi acute. Body long cylindrical, the segments of uniform size and shape, not thickened much behind, but still as much so as in the larva of *Megachile*, for instance, and in this respect very different from Crabronid and Pompilid larvæ. The pleural region is not prominent. The body is very cylindrical; the tip broad obtuse, the terminal tergites and sternites broad and flat, together forming an orbicular area, very different from the exerted prominent knob-like ending of the larva of *Pompilus*.

It differs from the larva of *Pompilus* in the short curvilinear testaceous line, in the short broadly trapezoidal clypeus and the distinct exerted labrum. The mandibles differ from those of *Pompilus* in being tridentate and twice as long. The front edges of the segments are thickened, but not so convex as in *Pompilus*, giving a serrate appearance to the body. Tip rounded, full, not nearly so acute as in *Pompilus*. The larvæ of the two genera differ greatly; indeed, more than one would suspect, considering that they are representatives of two allied families.

***Pelopæus cementarius* (Drury) (flavipes Fabr.).**

Pupa.—The pupa of *Pelopæus* differs from that of *Polistes* and *Vespa* in the head being raised more from the pectus. The palpi are visible along their whole length. The legs are much longer, and the pedicel is of the same shape as in the adult. The head is much as in the imago. The mandibles long, slender, curved, covering the base of the maxillæ and lingua. The scape of the antennæ is oblique; the flagellum reaches to the posterior coxæ, resting between the two anterior pairs. The maxillæ are slender, not reaching to the entire labium. Of the rhabdites or blades of the ovipositor, only one pair is visible; the

inner ones are enveloped by the outer pair, which are united into one piece in *Polistes*; above, a small inner pair lies between, slenderer than those beneath. The edges of the abdominal segments are a little more thickened than usual, and slightly spinulose; on the side is a prominent long slender tubercle.

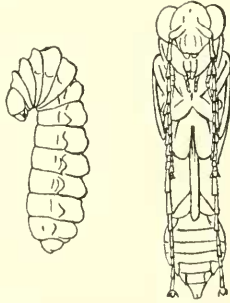


Fig. 1. Larva and pupa of *Pelopæus cementarius*. (Trouvelot del.)

Sphex tibialis St. Farg.

Larva.—The body of the living larva is somewhat flask-shaped, slightly flattened, gradually widening from the head towards the posterior fifth of the body. The head is small and not prominent. There are 13 segments behind the head; the pleural or lateral ridges are rather prominent, those of each segment well defined, the posterior half of each segment much thickened, giving a crenulate outline to the tergum; the last segment is full, orbicular, the end of the abdomen being full.

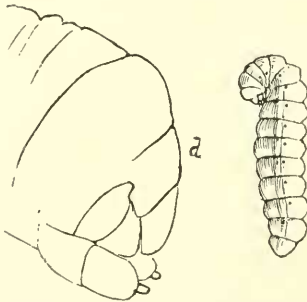


Fig. 2. Larva of *Sphex tibialis*; a, side view of head, enlarged. (Trouvelot del.)

Stigmus fraternus Say.

Larva.—Body moderately long, slender, cylindrical, tapering slowly towards both extremities; the segments short, very convex, sub-

acutely so, so that dorsally there are subacute extensions of the thickened posterior portion. The terminal segments cylindrical, less convex, the terminal or tenth ring cylindrical, not flattened, large and full. Beneath, the rings are very convex. The pleural region not very distinctly marked. Color a beautiful roseate tint. Head long and as narrow as usual, though no more so; full and convex; supra-clypeal piece large, subtriangular, indistinctly marked. Antennal fossa rudimentary; placed rather farther back, or rather the clypeus is so much shorter than usual as to give it the appearance of being situated farther back. Clypeus short and broad, transversely oblong, base convex, front edge a little concave, as broad as the base; the sides parallel, acutely convex. Labrum large chitinous, transparent, as broad as the clypeus, bilobate, with a distinct median line. Mandibles rather slender, long, incurved, very acute. Maxillæ cylindrical, 2-jointed, tip or rudiment of the palpi minute. Labium much as usual, flattened, cylindrical, ending in a transverse chitinous line, being the rudiment of the lingua? on each side of which are the minute rudiments of the palpi.

Described from living specimens.

Pupa.—Head full, convex in front, much as in the adult; ocelli prominent; papillæ acute. Antennæ folded over the base of the narrow, acute, curved, prominent mandibles as described in *Cemonus*, and reaching to the first pair of trochanters. Lingua much shorter than in *Cemonus*; the palpi very small and slender. The fore legs are very slender, the tarsi just reaching to the middle trochanters, while the hind tarsi reach to the middle of the abdomen. The ovipositor is exerted, the wings covering the middle tibiæ and femora. Length, .15 inch.

It differs from *Cemonus* in generic characters observed in the imago. The palpi are much smaller; lingua and maxillæ much shorter, and mouth-parts generally much weaker. The head is more ovate, full and convex in front, where it is sunken and depressed in *Cemonus*. The antennæ are much slenderer, and the abdomen longer and slenderer, as the hind legs scarcely reach to the middle, where in *Cemonus* they pass beyond. The mandibles are much more slender, their tips being more acute.

***Cemonus inornatus* (Say).**

Larva.—Body oblong, long, and greatly flattened, the lateral ridges of that segment very large, broadly triangular, becoming larger and more pointed towards the end of the body. The body does not narrow any until the 11th segment, when it suddenly tapers off. Above

the rings are broad, slightly convex, in the middle of the body the dorsal arches of the segments are thickened suddenly so as to give a serrate outline to the back when seen laterally; the prominences being largest and most acute on the 4th to 7th segments of the body, counting from the head. The lateral region is very distinctly separated from the dorsal. The prothoracic segment narrow and rounds a little toward the front edge. The head is flattened. Tip of abdomen rounded obtuse, 10th segment small, broad, short, obtuse, not being cylindrical and rounded as usual. Length, .32 inch.

The above are mostly generic characters. Compared with the larva of *Rhopalum* there are great differences. The head is broad and unusually flattened, the rudiments of the eyes are more prominent and conspicuous than before, owing to the flatness of the surface. The supra-clypeal piece is unusually short, broad, flat and triangular. The clypeus is very short, subtrapezoidal. The posterior half is sub-triangular, smooth, and the anterior third is roughened with the edge straight. The labrum is nearly three times as broad as long, slightly bilobate, less so than in *Blepharipus*. The mandibles are large, stout, incurved, unequally bidentate, the inner tooth very distinct, large, dark and chitinous. Maxillæ and labium rather small, cylindrical; palpi acute, as usual.

Its broad flattened head and body, serrate sides and back, and the conspicuously bidentate mandibles and prominent eye-rudiments, as well as the peculiar flattened abdominal tips, will at once distinguish the larvæ of this genus.

The larva lives in irregular burrows like those of *Rhopalum*. All the genera of this group apparently have similar habits, living in loose galleries in the elder and other pithy plants. The larvæ were found, May 14th, in irregular borings in the larger stems of the elder; the galleries were short, not communicating, and were filled with Aphides, whose black carcasses were found remaining in the old burrows, which were over half an inch long and about .12 inch broad.

Pupa.—Front much excavated and depressed, eyes and ocelli very prominent. Antennæ bent angularly over the base of the mandibles so that the scape does not rest flat on the front but is raised at a considerable angle before the base of the flagellum bends over; they reach to the first trochanters, the joints are round, very convex, with broad sutures between. Mandibles very long and prominent, lingua short, not much longer than broad, square at the edge. Maxillæ not distinguishable; maxillary palpi 6-jointed, long and slender, reaching

to fourth joint from end of antennæ. Labial palpi 3-jointed, reaching to fourth joint of maxillary palpi. Legs long and slender, especially the tarsi. Wings long, partially overlapping the middle tibiæ. The hind tarsi reach to beyond the middle of the abdomen. Thorax and abdomen much as in the adult. Ovipositor not retracted. Hind femora and tibiæ folded in the pedicel, between the thorax and abdomen. Length .25 inch.

Passalæcus mandibularis *Cresson.*

Pupa.—♀. The head is much as in *Cemonus*, but the eyes are much narrower. The mandibles are greatly elongated, projecting far beyond the head, the tips meeting but not crossing, as they do in the imago. The antennæ are folded at right angles over the base of the jaws, reaching back to the base of the mesosternum. The maxillæ are very short, merely enclosing the labium whose base is wedged in between them. Both pairs of palpi are shorter and thicker than in *Cemonus*. The labium is distinctly triangular, with the front edge square; the palpi are 4-jointed, the basal joint minute, third longer than the second; fourth nearly twice as long as the third, reaching just beyond the base of the maxillary palpi, the latter reaching to the last joint but two of the antennæ. Wings as in *Cemonus*, though a little shorter. The limbs are arranged much as in *Cemonus*; the forelegs reach to the trochanters of the 2d pair, and the hind tarsi to the middle of the 4th abdominal segment. The abdomen is sessile, regularly ovate, the basal segment being $\frac{2}{3}$ as long as broad, as in *Cemonus*, the tip ending in a long slender needle-like mucronate spine; the ovipositor is long and slender, exerted, the inner pair of rhabdites chitinous, the middle pair very small, slender and filiform, the 3d and outer pair somewhat incurved, much shorter than those in *Cemonus*, which are long and straight, while in *Cemonus* the mesial pair are not chitinous in the specimens before me, which, however, is apparently of the same age as those of *Passalæcus*; thus showing excellent generic characters.

In the specimen examined, which is a pupa to all intents and purposes, the body is surrounded with a subimago pellicle. It is easily recognized by its long-curved projecting jaws, the long slender body. It was found in small galleries in the stem of syringa the last of May, in company with *Cemonus*.

Rhopalum pedicellatum *Pack.*

Larva.—Body short and thick, tapering rapidly towards the head and tip of abdomen, flattened beneath a little, very convex above; seg-

ments convex, those of the thorax broad, regularly convex, smooth, not thickened posteriorly; quite different from those of the abdomen. The abdominal segments shorter posteriorly above than the thoracic ones. The posterior portion of the segment thickened so as to form a rounded tubercle, which is very prominent and distinct when the body is much curved. This portion is thickened; the tuberculous portion is much smaller in proportion to the rest of the segment than usual in *Apidæ*. The tip is quite extensible, subacute, terminating in a small knob-like portion. Genitals not apparent, the skin being too thick. A few sparse long hairs over the body, in which respect this genus differs from those of the other families, and it differs in its elongated extensible tip, though it is probable that this part became contracted in alcohol; when contracted, the terminal segment is rather square, not being rounded at the tip. Length of body .25 inch.

The larva burrows in the dust made by the larva of an *Egeria* in the pith of the *Spiræa*, spinning little thin silken cocoons, half a dozen of them occurring in a space of the stem an inch long, lying loose in the galleries, some lying across the stem, and others lengthwise. The cocoon is very thin and slight compared with that of *Crabro sex-maculata*, being composed of only a few silken threads. Found April 18th.

Pupa.—♀. The middle joint of the antennal scape is bent at right angles to the flagellum, the third joint being continuous with the flagellum, while in *Pelopæus flavipes* it is more oblique, as the front of the head is longer and more horizontal, while in *Rhopalum* it is at right angles to the longitudinal axis of the body. The head is more vertical, less flattened on the pectus of the thorax. Mandibles thick and stout, convex, much more so than in *Pelopæus*. The antennæ do not quite reach to second pair of trochanters; in *Pelopæus*, they reach beyond the third pair; they also reach the tip of the maxillary palpi, which in *Pelopæus* reach half their length. They rest close to each other along the median line of the body. The maxillary palpi are straight, not slightly elbowed near the base; they reach to the tip of the antennæ; the labial palpi are proportionately longer, reaching nearer the tip of the maxillary pair than in *Pelopæus*, and less elbowed or angulated at tip. The anterior tarsi end just before the middle trochanters; the middle tarsi terminate near the end of the pedicel of the abdomen, and the third tarsi end near the middle of the third abdominal segment. Tip of abdomen with the terminal tergite very acute, elongated, extending beyond the ovipositor; the last sternite is oblong, flanked on each side by two cylindrical pieces. On the head between

the ocelli and antennæ are two very prominent acute tubercles. The ocelli are very large; the thorax much as in the imago, but broader, and the propodeum is more horizontal, the enclosure being indistinct; the mesial furrow well marked. The pedicel is broader than in the imago; the rings of the abdomen more dentate on hind edges, while the abdomen, including the propodeum, is much longer than in the imago.

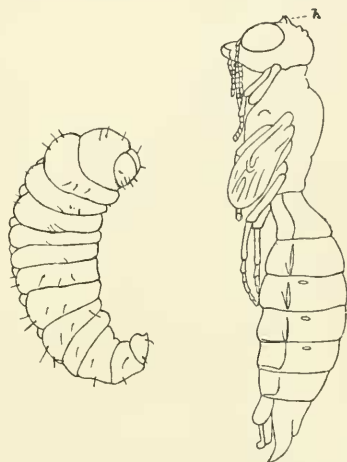


Fig. 3. Larva and pupa of *Rhopalum pedicellatum*, enlarged; *h*, temporary tubercles on head of pupa. (Trouvelot del.)

These details of difference in the pupa apply but to the mouthparts, which are not withdrawn in the pupa, as in the imago, and would not, therefore, be so well noticed in the imago, where these parts are much more difficult to compare.

It was interesting to find half-grown larvæ associated with the mature pupa April 18th, showing a possibility of two broods.

Odynerus (probably *albophaleratus* Saussure).

Larva.—The head is considerably longer than in *Vespa*; more elongated, narrower and more convex, globose. The clypeus and mouth-parts are more advanced, more prominent. Situation of eyes is not indicated by the narrow testaceous stripe. The supra-clypeal triangular piece is more distinctly marked than in *Vespa* or in the larval Apidae; it is obtusely pointed behind at the apex. The site of the antennæ forms a depressed area on a distinct piece between the eyes and supra-clypeal piece.

The clypeus is very distinct, transversely oblong, with the edges square. The labrum is large and divided deeply with two lobes, which are separated as if composed of two pieces; they overlap the mandibles so that the black tips only remain in sight. Mandibles short, stout, very thick, tridentate; the teeth short, subacute, the innermost being the smallest. The maxillæ and labium are much as usual; prominent, bulging at the end, terminating in the usual papillæ; the lingua represented by a transverse chitinous line. The body is cylindrical, long, a little curved upon itself. The skin is hard and thick, so that the genitals, nerves and dorsal vessel do not show through it. The segments are short, very convex, much thickened, especially on the tergum and the pleural line. The posterior half of each segment is more thickened than in any of the other genera of Vespidæ or Apidæ observed, and also the pleural ridges, giving to the outline of the back a dentate or serrated appearance. Tip of abdomen moderately obtuse.

The larva of *Odynerus* differs from *Vespa* in the long head, square clypeus, the very distinct bilobed labrum, which are unusually deeply fissured, and by the tridentate, stout mandibles; while by the serrated outline of the back it is related more to the larval Crabronidæ and Pompilidæ. It is interesting to observe the distinct supra-clypeal piece.

Odynerus albophaleratus *Saussure*.

Pupa.—Compared with *Vespa* the head is much more horizontal, and there is no supra-clypeal tubercle; the mandibles are much more elongated; the maxillæ and lingua are as much exposed and exerted beyond the tips of mandibles as in *Vespa*, but the whole reach farther towards the end of the body, to the 2d trochanters. The maxillæ and lingua are a little slenderer than in *Vespa*. The antennæ are more oblique at the base, not being bent at nearly right angles as in *Vespa*. They extend just to the 3d trochanters, as the thorax and body generally is wider and shorter than in *Vespa*. The legs spread a little farther apart, but are proportionally of the same length and reach the same relative distance from the end of the abdomen as in *Vespa*. The hind tibial spaces are shorter and smaller than in *Vespa*. The abdomen is much shorter and more spherical; the terminal joints are shorter, being withdrawn more within the abdomen. The ♂ genitals are more acute, the terminal sternite much shorter, smaller and less exerted, than in *Vespa*, while the blades of the ovipositor are much exerted, and longer and slenderer.

Seen sideways, the head of *Odynerus* is more globular, the eyes

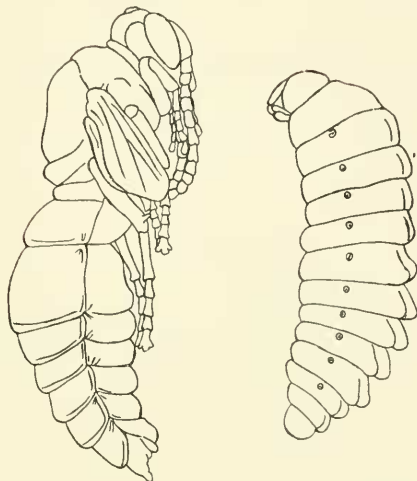


Fig. 4. Larva (enlarged 9 times), and pupa of *Odynerus albophaleratus*. (Trouvelot ael.)

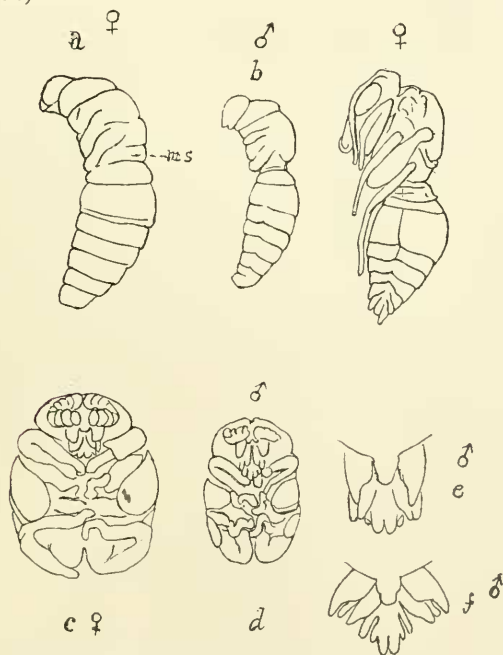


Fig. 5. Semipupal stages *a, b*, of *O. albophaleratus*; *c, d*, under side of head and thorax of semi-pupa; *e, f*, mouth-parts at different stages; *m s*, median segment. (Emerton del.)

more indented, the thorax more convex, with the limbs and wings arranged much the same. The propodeum is longer and slenderer, and the subpedunculate abdomen is as in the imago, the two first segments being greatly lengthened over the terminal short retracted ones, and the tip is more incurved, so that the hind tarsi reach to the tip, and the abdomen is rounded ovate, where in *Vespa* it is oblong.

A NEW ANISOTA.

BY HARRISON G. DYAR.

Many larvæ of the following species were found at West Palm Beach, Florida, on live oak in January, 1896. I am indebted to Mr. L. H. Joutel for obtaining me food plants for them during the winter.

Anisota consularis, sp. nov.

Male; smaller than the female; body ochreous brown, wings dark purplish brown, a larger ill-defined subhyaline space in the center of the fore wings; a round white discal dot. Terminal space more purplish than the basal part of the wing.

Closely resembles the male of *A. senatoria* in color, but the hind wings are rounded as in the female, not angulated at apex and anal angle, and the t.-p. line is much more obscure.

Female; wings purplish brown, basal and terminal spaces darker; a white discal dot and faint blackish strigæ. Hind wings with a purplish mesial band.

Darker than either *senatoria* or *stigma*, the lines less distinct; wings opaque, not thinly scaled as in *virginiensis*. Types male and female, bred from larvæ.

Larva. Primary spines black, secondary granules sparse, white. Head shining red brown, width 3.5 to 4 mm. Body red-brown, a dorsal, subdorsal (i), lateral (iii), stigmatal and subventral clouded black bands. Dorsal and stigmatal bands harp and narrow, the others clouded, the subventral filling the whole space. All except the subventral are bordered by white shaded lines on the lower side, that below the stigmatal line very distinct. All the lines become obsolete on joint 12, leaving the anal end and all the feet red-brown. In large examples the skin has a fleshy tint, different from the head and plates, while the shaded lines tend to be broken at the primary spines.

The following table will separate the larvæ of *Anisota*.

General color not green.

With secondary white granules.

Brown without distinct black bands.....**stigma**.

A subdorsal and stigmatal dark red stripe and faint black

bands.....**virginiensis**.

Ground color relieved by white shades; nine distinct black

bands.....**consularis**.

Without white granules; heavily black banded.....**senatoria**.

General color green.....**rubicunda**.